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This experiment tested the hypothesis that rewards given for progress during competency development promote children's mathematical skill development, percepts of self-efficacy, and interest. Children received didactic instruction in division operations and were offered rewards contingent on their actual progress, rewards for simply participating, or no rewards. Results showed that progress-contingent rewards led to higher task involvement, skill development, perceived efficacy, and interest. Regardless of treatment, perceived efficacy bore a significant and positive relationship to subsequent task interest in the absence of incentives. (Author/MNS)

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Progress-Contingent Rewards:

Do They Boost Children's Achievement?

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Abstract

This experiment tested the hypothesis that rewards given for progress during competency development promote children's mathematical skill development, percepts of self-efficacy, and interest. Children received didactic instruction in division operations and were offered rewards contingent on their actual progress, rewards for simply participating, or no rewards. Results showed that progress-contingent rewards led to higher task involvement, skill development, perceived efficacy, and interest. Regardless of treatment, perceived efficacy bore a significant and positive relationship to subsequent task interest in the absence of incentives.

Progress-Contingent Rewards:
Do They Boost Children's Achievement?

The primary purpose of this study was to determine the effects of tangible, extrinsic rewards on children's percepts of self-efficacy and achievement in the context of mathematical competency development. The conceptual focus was Bandura's theory of self-efficacy (Bandura, 1977, 1981). According to this theory, different influences change behavior in part by strengthening percepts of self-efficacy. Self-efficacy is concerned with judgments about how well one can organize and execute courses of action in situations that may contain ambiguous, unpredictable, and stressful elements. Perceived efficacy can affect choice of activities, effort expended and persistence in the face of difficulties. Efficacy information can be conveyed through enactive attainments, socially comparative vicarious means, social persuasion, and indices of physiological arousal.

In this conception, the anticipation of a rewarding consequence should influence children's percepts of self-efficacy and achievement in at least two ways. The motivational aspects of reward anticipation should boost task accomplishments, which serve to raise perceived efficacy. Further, telling children that they can earn rewards for their performance accomplishments should convey that they possess the requisite efficaciousness to perform well.

There is an abundance of literature demonstrating that the offer of a reward boosts performance (Dornbush, 1965; Glucksberg, 1962; Goyen & Lyle, 1971; McCullers, 1978). In studying this effect, however, one factor to consider is the reward contingency. Rewards may be offered commensurate with level of performance or merely for engaging in the task. In the present study,

low-achieving children received training materials that provided instruction in mathematical division and practice opportunities. Some children (progress-contingent reward) were told that they would receive points for each problem they solved and that they could exchange the points for prizes. A second group (task-contingent reward) was told that they would receive points for engaging in the task and that the points could be exchanged for prizes. A third group (unexpected reward) was unexpectedly allowed to choose prizes at the end of training for their participation.

Progress- and task-contingent rewards may have markedly different effects on perceived efficacy and achievement. Progress-contingent rewards should promote task accomplishments through their motivational effects and convey that children are efficacious enough to succeed. In contrast, when rewards are given simply for engaging in a task they should not be as highly motivating. Further, they may actually convey negative efficacy information; children may infer that they are not expected to accomplish much and that they are not very efficacious.

A secondary purpose of this study was to determine how different reward contingencies influence interest. Although there is much interest research, most of it has investigated the effects of extrinsic rewards on initially high interest. Although there are some exceptions, the general findings are that when rewards are given for engaging in a task they decrease interest but that when they signal task competence they sustain or promote interest (Karniol & Ross, 1977; Lepper & Greene, 1978; Rosenfield, Folger, & Adelman, 1980; Ross, 1976). Research also shows that competency information indicating successful performance promotes interest in the absence of extrinsic rewards (Boggiano & Ruble, 1979; Pittman, Davey, Alafat, Wetherill, & Kramer, 1980).

A variety of theoretical approaches postulate that increased engagement in an activity is in part a function of persons' perceived competence for that activity (Atkinson, 1957; Bandura, 1981; Deci, 1975; Harter, 1978). Children who recognize that they lack skills to perform an activity are not apt to perform it. But when they perceive that they have become more skillful they should also show greater interest. Bandura and Schunk (1981) found that posttreatment interest was significantly and positively related to perceived efficacy derived from performance attainments during treatment.

The present sample of low-achieving children was not expected to demonstrate much initial interest in solving division problems. It was hypothesized that offering rewards for performance attainments would most effectively promote interest, since such rewards should indicate to children that they were becoming more skillful and thereby promote perceived efficacy. In contrast, offering rewards for task engagement was not expected to promote interest as well. Regardless of treatment, perceived efficacy was hypothesized to be significantly and positively related to interest.

Method

Subjects

Subjects were 36 children (M = 10.1 years) of predominantly middle-class backgrounds. Teachers initially nominated children who lacked division skills. The 25 females and 11 males were drawn from two elementary schools. Children were individually administered the pretest by an adult tester.

Pretest

Interest test. Children were given three stacks of papers of eight pages each. One stack contained four rows of digit-symbol problems per page adapted from the WISC (Wechsler, 1974). The second stack contained three division

problems per page of varying difficulty. On each page, problems were cast in two different formats. In one format, the divisor and dividend were shown and children had to solve for the quotient. Problems were also cast in this format on the skill test and during training. The other problems were fully worked but an occasional digit was missing in the divisor, dividend, quotient, or solution steps. The task was to solve for the missing digits. The third stack consisted of five problems per page. In the first problem, the divisor and dividend were shown; in the remaining problems only the divisor was shown. The task required that children solve the first problem, then rewrite the quotient as the dividend for the second problem. This sequence was continued for the remaining three problems. Multiple formats were included because as children become more efficacious they gain little competency information by solving problems cast in a familiar format.

Children were informed that they could work on any activity or combination; the choice was theirs. They worked alone and out of sight of the tester for 40 minutes. The measure of interest was the number of problems solved regardless of format.

Self-efficacy judgments. Children's perceived efficacy for solving division problems was measured on the day after the interest test following procedures developed earlier (Bandura & Schunk, 1981; Schunk, 1981, in press). The efficacy scale ranged from 10 to 100 in 10-unit intervals from high uncertainty through intermediate values to complete certitude. Children were shown 14 sample pairs of division problems for about 2 secs each. This time allowed assessment of difficulty but was too brief to attempt solutions. The two problems of each pair were similar in form and operations required. Children privately judged their certainty of being able to solve the type of

problem depicted by circling an efficacy value. Each pair corresponded in form and operations required to one problem on the ensuing skill test but they were not the same problems. Children were judging their capability to solve types of problems and not whether they could solve any particular problem. The measure of efficacy was the number of judgments in the upper half (certainty side) of the efficacy scale.

Division skill test. Immediately following the efficacy assessment, children received the skill test consisting of 14 problems ranging from 1-3 digits in the divisor and 2-5 digits in the dividend. Half of these problems were similar in form and operations required to some of the problems children would solve during training, whereas the other half were more complex. For example, during training children had to "bring down" numbers 1-2 times per problem, whereas some test problems required bringing down 3 numbers. The measure of skill was the number of problems that children solved correctly.

The tester presented problems to children one at a time. Children were told to examine each problem and to place the page on a completed stack when they were through solving it or chose not to work it any longer. The tester recorded the time children spent with each problem; these persistence times were summed and averaged.

Training Procedures

Children were randomly assigned within sex to one of three treatment groups(n = 12): progress-contingent rewards, task-contingent rewards, unexpected rewards. On two consecutive school days, children received 40-minute training sessions during which they worked on two sets of instructional material. Each set was similar in format except that the first set covered 1-digit divisors whereas the second set covered 2-digit divisors. The first

page in each set contained a step-by-step worked example that involved bringing down one number. Next to each step appeared a strategy descriptor: check, multiply, check, copy, subtract, check, and bring down. The next page contained a practice problem, and the following 15 pages contained 2-3 problems per page.

Initially, an adult proctor verbally reviewed the explanatory page while the child followed along. If children asked for further assistance, the proctor reread the relevant narrative but did not supplement it. After children worked the practice problem, the proctor gave the appropriate experimental instructions and retired to an out-of-sight location. Children worked problems individually during the session.

Treatment Conditions

Progress-contingent rewards. The proctor informed these children at the start of each session that because they agreed to participate in the project they would earn 5 points for each problem solved and that at the end of the second session they would exchange the points for prizes equal in monetary value to the points. Prizes to choose from included magic markers, erasable pens, stickers, and small notebooks. In this and the other conditions, the proctor stressed the importance of careful work.

Task-contingent rewards. The proctor informed these children that because they agreed to participate in the project they would receive some prizes at the end of the second session. Children were told that they would draw a number from a hat and that this would equal the monetary value of their prizes. This group controlled for the effects of reward anticipation included in the above condition.

Unexpected rewards. These children were given no reward information. At the end of the second session, they were told that because they agreed to participate in the project they could draw a number from a hat and choose prizes. This group controlled for the effects of receiving a reward included in the other treatments. Children in this and the task-contingent condition drew the number $2.00. This was chosen since pilot work indicated that children could complete 40 problems with diligent effort.

Posttest

The posttest was administered the day after the second training session. It was similar to the pretest except that a parallel form of the skill test was used to eliminate possible problem familiarity, and perceived efficacy was assessed before and after the skill test. The former efficacy appraisal yields a measure of treatment effects, whereas the latter serves as a predictor of subsequent interest. The interest test was readministered a week later to minimize potential satiation effects due to extensive exposure to division. Prior to these assessments children were told that the reward contingencies were not in effect. For any given child, the same tester administered both the pre- and posttests. The tester was blind to the child's experimental assignment and had not served as the child's proctor.

Results

There were no significant differences due to sex or experimenter on any pre- or posttest measure; the data were therefore pooled for subsequent analyses. Treatment groups did not differ on any pretest measure nor on amount of money earned (progress-contingent condition M = $2.06). Pre- and posttest means and standard deviations are shown by experimental condition in Table 1. Analysis of covariance procedures were applied to posttest scores using the appropriate pretest score as the covariate. Significant F ratios were further analyzed

using the Newman-Keuls multiple comparison test (Kirk, 1968).

Insert Table 1 about here

Analysis of covariance conducted on the skill measure revealed a significant main effect for treatment, F (2, 32) = 16.45, $p < .001$. Newman-Keuls comparisons showed that progress-contingent rewards led to significantly ($p < .01$) greater division skill than each of the other treatments, which did not significantly differ. ANOVA on the persistence measure yielded a non-significant treatment effect. A significant treatment effect was found on the self-efficacy measure collected prior to the skill test, F (2, 32) = 13.34, $p < .001$. Post hoc comparisons showed that progress-contingent rewards promoted percepts of efficacy significantly ($p < .01$) better than the other treatments, which did not differ. A similar pattern was found using self-efficacy scores collected after the skill test.

The number of problems that children completed during each of the two training sessions was analyzed using ANOVA procedures. No significant differences were found for the first session that covered 1-digit divisors. A significant treatment effect was found on the more difficult 2-digit divisors covered during the second session, F (2, 33) = 7.07, $p < .01$. Progress-contingent reward children solved significantly ($p < .01$) more problems than did children in the other groups, which did not differ. A similar pattern was obtained when ANOVA procedures were applied to the number of problems children solved correctly.

Analysis of covariance conducted on the interest measure yielded a significant treatment effect, F (2, 32) = 5.59, $p < .01$. Progress-contingent reward subjects showed significantly ($p < .05$) greater interest than children in the other treatments, which did not significantly differ.

To test the relationship of perceived efficacy to interest, children's posttest efficacy scores collected after the skill test were correlated with subsequent interest scores. Correlations were computed separately within each experimental condition and were averaged using an r to z transformation since there was no significant between-condition difference (Edwards, 1976)

This correlation was significant, $r(34) = .51$, $p < .01$. Regardless of treatment, therefore, the more efficacious that children felt following the skill test, the more interest in solving division problems they subsequently demonstrated.

Discussion

The present study provides evidence that progress-contingent rewards promote children's task involvement, percepts of efficacy, and skill development. In contrast, offering children rewards for simply engaging in a task does not promote these outcomes over what can be expected from merely providing training. These findings are consistent with predictions from self-efficacy theory (Bandura, 1981). Children who are told that they will receive rewards based on progress are apt to be motivated to work diligently. This also conveys that children are efficacious and capable of succeeding. Percepts of efficacy are subsequently validated as children observe actual progress. In contrast, offering rewards for engaging in a task may convey that progress is not important and may even undermine percepts of efficacy if children infer that they lack ability because not much is expected of them.

The present results are also consistent with other lines of theorizing. Deci, for example, distinguishes between informational and controlling functions of rewards (Deci, 1975; Deci & Porac, 1978). A reward may either convey information about one's capabilities or be used to control behavior, and the relative salience of each influences behavior. A salient informational aspect indicating successful performance should promote feelings of competence, whereas a salient controlling aspect may lead to perceptions of the reward as the cause of the behavior and less task engagement. The informational aspect should be highly salient when rewards are offered commensurate with progress, whereas subjects may be more likely to perceive a reward offered for engaging in a task as an attempt to control behavior.

A related idea is derived from attribution theory (Bem, 1967, 1972). Individuals form perceptions of the causes of their behavior, and come to believe that their behavior is extrinsically or intrinsically motivated. Persons are more likely to believe they are extrinsically motivated when a reward for engaging in the activity is salient. This perception can lead to less task engagement. In the present study, it is possible that the rewards were more salient for task-contingent children than for progress-contingent subjects. The latter group may have attended more to solving problems due to their functional value for earning points and thus have been somewhat distracted from the rewards. In support of this idea, Ross (1975) found that children who were distracted from thinking about a reward demonstrated greater task engagement than children who were instructed to think about the reward and those who were promised a reward but were given no ideation instructions.

The present results demonstrate the effectiveness of progress-contingent rewards in promoting interest. When children have no normative basis for judging their capabilities, as in the present study, progress-contingent rewards should convey a sense of competence, which in turn promotes interest.

This suggestion is supported by the strong, positive relationship of perceived efficacy to interest. This finding replicates that of previous similar research (Bandura & Schunk, 1981), and provides indirect support for the theoretical notion that perceived competence influences subsequent task engagement in the absence of incentives (Bandura, 1981; Deci, 1975).

This study also has practical significance. Parents and teachers often offer children rewards for engaging in an activity. The present results suggest that this practice may result in few, if any, benefits. Although it is true, as Lepper and Greene (1978) point out, that engaging in a task over time should result in increased skill proficiency, mere task engagement may convey little capability information to children. When rewards are clearly tied to progress, children gain better insight into what they are capable of doing. The prevalence of rewards in our educational systems suggests a closer look to determine how well they are promoting a sense of personal efficacy.

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TABLE 1

Pre- and Posttest Means and Standard Deviations

Measure	Phase	Reward Condition: Performance-Contingent M	Performance-Contingent SD	Task-Contingent M	Task-Contingent SD	Unexpected M	Unexpected SD
Skill[a]	Pretest	2.5	1.8	2.6	2.8	2.2	2.2
	Posttest	8.2	2.1	3.1	2.8	3.2	3.4
Persistence[b]	Pretest	53.9	46.5	47.9	32.1	43.0	40.8
	Posttest	74.3	54.9	56.5	26.9	58.9	35.0
Self-Efficacy[c]	Pretest[d]	5.2	2.9	3.9	4.1	5.0	3.6
	Posttest_1[d]	10.3	2.9	4.3	2.1	6.6	3.7
	Posttest_2[e]	10.7	2.7	5.3	1.8	6.1	3.3
Training Progress[f]	Session 1	26.4	6.1	27.2	5.6	25.5	7.0
	Session 2	15.7	3.4	12.3	4.7	8.0	6.4
Interest[g]	Pretest	8.3	5.8	11.2	6.7	10.4	5.0
	Posttest	16.2	9.2	10.2	8.3	9.2	7.5

Note. $N = 36$; $n = 12$.

[a]Number of accurate solutions on 14 problems.

[b]Average number of secs per problem.

[c]Number of efficacious judgments on 14 problems.

[d]Measured before the skill test.

[e]Measured after the skill test.

[f]Number of problems completed.

[g]Number of division problems worked.